CLAIMS:

1. A method of depositing a metal layer on a substrate, the method comprising:

providing a substrate in a process chamber;

introducing a process gas comprising a metal-carbonyl precursor in the process chamber;

creating a processing zone above the substrate;

maintaining a residence time for gaseous species in the processing zone that is shorter than about 120 msec; and

depositing a metal layer on the substrate by a thermal chemical vapor deposition process.

2. The method according to claim 1, wherein the residence time of gaseous species in the processing zone is shorter than about 70 msec.

3. The method according to claim 1, wherein the residence time of gaseous species in the processing zone is shorter than about 40 msec.

4. The method according to claim 1, wherein the process chamber pressure is less than about 300 mTorr.

5. The method according to claim 1, wherein the process chamber pressure that is less than about 100 mTorr.

6. The method according to claim 1, wherein the metal-carbonyl precursor flow is between about 0.1 sccm and about 200 sccm.

7. The method according to claim 1, wherein the substrate temperature is between about 300° C and about 600° C.

8. The method according to claim 1, wherein the substrate temperature is between about 400° C and about 500° C.

9. The method according to claim 1, wherein the metal-carbonyl precursor comprises at least one of $W(CO)_6$, $Ni(CO)_4$, $Mo(CO)_6$, $Co_2(CO)_8$, $Rh_4(CO)_{12}$, $Re_2(CO)_{10}$, $Cr(CO)_6$, and $Ru_3(CO)_{12}$.

10. The method according to claim 1, wherein the metal layer comprises at least one of W, Ni, Mo, Co, Rh, Re, Cr, and Ru.

11. The method according to claim 1, wherein the process gas further comprises at least one of a carrier gas and a dilution gas.

12. The method according to claim 11, wherein the process gas includes the carrier gas having a flow rate less than about 500 sccm.

13. The method according to claim 11, wherein the process gas includes the dilution gas having a flow rate less than about 2000 sccm.

14. The method according to claim 11, wherein the at least one of a carrier gas and a dilution gas comprises at least one of Ar, He, Ne, Kr, Xe, N_2, and H_2.

15. The method according to claim 1, wherein the creating comprises defining a volume using the substrate diameter and the gap between the substrate and a showerhead.

16. The method according to claim 1, wherein the gaseous species in the processing zone comprise the metal-carbonyl precursor and reaction by-products.

17. The method according to claim 16, wherein the gaseous species in the processing zone further comprise at least one of a carrier gas and a dilution gas.

18. The method according to claim 1, wherein the substrate comprises at least one of a semiconductor substrate, a LCD substrate, and a glass substrate.

19. A method of depositing a W layer on a substrate, the method comprising:

providing a substrate in a process chamber;

introducing a process gas comprising a $W(CO)_6$ precursor in the process chamber;

creating a processing zone above the substrate;

maintaining a residence time for gaseous species in the processing zone that is shorter than about 120 msec; and

depositing a W layer on the substrate by a thermal chemical vapor deposition process.

20. The method according to claim 19, wherein the residence time of gaseous species in the processing zone is shorter than about 70 msec.

21. The method according to claim 19, wherein the residence time of gaseous species in the processing zone is shorter than about 40 msec.

22. The method according to claim 19, wherein the process chamber pressure is less than about 300 mTorr.

23. The method according to claim 19, wherein the process chamber pressure that is less than about 100 mTorr.

24. The method according to claim 19, wherein the $W(CO)_6$ precursor flow rate is between about 0.1 sccm and about 200 sccm.

25. The method according to claim 19, wherein the substrate temperature is between about 300° C about 600° C.

26. The method according to claim 19, wherein the substrate temperature is about 400° C.

27. The method according to claim 19, wherein the process gas further comprises at least one of a carrier gas and a dilution gas.

28. The method according to claim 27, wherein the process gas includes the carrier gas having a flow rate less than about 500 sccm.

29. The method according to claim 27, wherein the process gas includes the dilution gas having a flow rate less than about 2000 sccm.

30. The method according to claim 27, wherein the at least one of a carrier gas and a dilution gas comprises at least one of Ar, He, Ne, Kr, Xe, N_2, and H_2.

31. The method according to claim 19, wherein the creating comprises defining a volume using the substrate diameter and by the gap between the substrate and the showerhead.

32. The method according to claim 19, wherein the gaseous species in the processing zone comprise the $W(CO)_6$ precursor and reaction by-products.

33. The method according to claim 19, wherein the gaseous species in the processing zone further comprise at least one of a carrier gas and a dilution gas.

34. The method according to claim 19, wherein the substrate comprises at least one of a semiconductor substrate, a LCD substrate, and a glass substrate.

35. A processing system for depositing a metal layer on a semiconductor substrate, the system comprising:

a process chamber;

a substrate holder for receiving a substrate;

a heater for heating the substrate;

a precursor delivery system for introducing a process gas in the process chamber, where the process gas comprises a metal-carbonyl precursor;

a vacuum system; and

a controller for controlling the processing system, wherein

a processing zone is defined about the substrate, and the delivery system and the vacuum system cause the residence time for gaseous species to be shorter than about 120 msec in the processing zone during thermal chemical vapor deposition of a metal layer on the substrate.

36. The processing system according to claim 35, wherein the residence time of gaseous species in the processing zone is shorter than about 70 msec.

37. The processing system according to claim 35, wherein the residence time of gaseous species in the processing zone is shorter than about 40 msec.

38. The processing system according to claim 35, wherein the process chamber pressure is less than about 300 mTorr.

39. The processing system according to claim 35, wherein the process chamber pressure is less than about 100 mTorr.

40. The processing system according to claim 35, wherein the metal-carbonyl precursor flow rate is between about 0.1 sccm and about 200 sccm.

41. The processing system according to claim 35, wherein the substrate temperature is between about 300° C and about 600° C.

42. The processing system according to claim 35, wherein the substrate temperature is between about 400° C and about 500° C.

43. The processing system according to claim 35, wherein the metal carbonyl precursor comprises at least one of $W(CO)_6$, $Ni(CO)_4$, $Mo(CO)_6$, $Co_2(CO)_8$, $Rh_4(CO)_{12}$, $Re_2(CO)_{10}$, $Cr(CO)_6$, and $Ru_3(CO)_{12}$.

44. The processing system according to claim 35, wherein the metal layer comprises at least one of W, Ni, Mo, Co, Rh, Re, Cr, and Ru.

45. The processing system according to claim 35, wherein the process gas further comprises at least one of a carrier gas and a dilution gas.

46. The processing system according to claim 45, wherein the at least one of a carrier gas and a dilution gas comprises at least one of Ar, He, Ne, Kr, Xe, N_2, and H_2.

47. The processing system according to claim 35, wherein the processing zone defines a volume using the substrate diameter and the gap between the substrate and a showerhead.

48. The processing system according to claim 35, wherein the substrate comprises at least one of a semiconductor substrate, a LCD substrate, and a glass substrate.

49. The processing system according to claim 35, wherein the heater comprises at least one of a resistive heater and a lamp heater.